What is claimed is:

1. A memory management apparatus for accessing a physical page
mapped according to mapping information to a logical page that
includes a logical address specified by an access request, the
mapping information showing a one-to-one mapping between a
plurality of logical pages and a plurality of physical pages,
the logical pages being defined by dividing a logical address
space by a predetermined size, each of the physical pages
functioning to physically retain data of the predetermined size
and degrading in storage performance each time an access is made
thereto, the apparatus comprising:

an access frequency index storage unit operable to store
an access frequency index for each logical page, the access
frequency index indicating an occurrence frequency of an access
request specifying a logical address included in a corresponding
logical page;

a degradation index storage unit operable to store a
degradation index for each physical page, the degradation index
indicating a degree of degradation in storage performance of
a corresponding physical page; and

a degradation leveling unit operable to (i) exchange
retained data between a first physical page and a second physical
page, the first physical page being mapped according to the
mapping information to a specific logical page of which an access
frequency index is greater than or equal to a first threshold,
and the second physical page having a degradation index that

26   is less than or equal to a second threshold, and (ii) update

27   the mapping information so as to show that the specific logical

28   page is mapped to the second physical page.

1   2. The memory management apparatus according to Claim 1, further

2   comprising:

3   a cache storage unit operable to store, for each of up

4   to a predetermined number of the physical pages, cache data that

5   is a copy of data retained in a corresponding physical page and

6   that is accessed instead of the original data, and to write,

7   if cache data has been modified as a result of a subsequent access,

8   the modified cache data back to a corresponding physical page;

9   and

10   a degradation index updating unit operable to add a first

11   value to a degradation index of each physical page that retains

12   original data of cache data stored in the cache storage unit,

13   and add a second value to a degradation index of each physical

14   page to which modified cache data has been written back.

1   3. The memory management apparatus according to Claim 2, wherein

2   the degradation index updating unit adds, at a time when

3   cache data is invalidated or replaced by data retained in another

4   physical page, a sum of the first value and the second value

5   to a degradation index of a physical page storing original data

6   of the cache data if the cache data has been modified, and adds

7   the first value to the degradation index if the cache data has

8   not been modified.

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1　4. The memory management apparatus according to Claim 2, further

2　comprising

3　　　an access frequency index updating unit operable to add

4　the first value to an access frequency index of a logical page

5　that is mapped according to the mapping information to each

6　physical page retaining original data of cache data stored in

7　the cache storage unit, and to add the second value to an access

8　frequency index of a logical page that is mapped according to

9　the mapping information to each physical page to which modified

10　cache data has been written back.

1　5. The memory management apparatus according to Claim 4, wherein

2　　　the access frequency index updating unit adds, at a time

3　when cache data is invalidated or replaced by data retained in

4　another physical page, a sum of the first value and the second

5　value to an access frequency index of a logical page that is

6　mapped according to the mapping information to a physical page

7　retaining original data of the cache data if the cache data has

8　been modified, and adds the first value to the access frequency

9　index if the cache data has not been modified.

1　6. The memory management apparatus according to Claim 2, wherein

2　　　the cache data storage unit further stores, at a time of

3　storing cache data, a cache access frequency index for the cache

4　data, an initial value of the cache access frequency index being

5　set to "0",

6　　　the memory management apparatus further comprising:

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7   a cache access frequency index updating unit operable to
8   increment a cache access frequency index of cache data in response
9   to an access to the cache data; and
10   an access frequency index updating unit operable to compare,
11   for each piece of cache data, (i) an access frequency index of
12   a logical page that is mapped according to the mapping information
13   to a physical page retaining original data of a corresponding
14   piece of cache data and (ii) a cache access frequency index of
15   the corresponding piece of cache data, and to update the access
16   frequency index with the cache access frequency index if the
17   cache access frequency index is greater than the access frequency
18   index.

1   7. The memory management apparatus according to Claim 6, wherein
2   the access frequency index updating unit performs the
3   update at predetermined time intervals and resets all the cache
4   access frequency indexes to "0".

1   8. The memory management apparatus according to Claim 6, wherein
2   the access frequency index updating unit calculates, for
3   each piece of cache data, a normalized cache access frequency
4   index by normalizing a cache access frequency index based on
5   a time period during which a corresponding piece of cache data
6   is retained in the cache storage unit, compares the normalized
7   cache access frequency index and an access frequency index of
8   a logical page mapped according to the mapping information to
9   a physical page storing original data of the corresponding piece

10　　of cache data, and updates the access frequency index with the

11　　normalized cache access frequency index if the normalized cache

12　　access frequency index is greater than the access frequency

13　　index.

1　　9. The memory management apparatus according to Claim 1, wherein

2　　　　each logical page has a generic logical address that is

3　　included in a corresponding logical page,

4　　　　the memory management apparatus further comprising:

5　　　　a detecting unit operable to detect an access request

6　　specifying any of the generic logical addresses;

7　　　　a degradation index updating unit operable to increment

8　　a degradation index of a physical page mapped according to the

9　　mapping information to a logical page that includes a generic

10　　logical address specified by an access request detected by the

11　　detecting unit; and

12　　　　an access frequency index updating unit operable to

13　　increment an access frequency index of the logical page that

14　　includes the generic logical address specified by the detected

15　　access request.

1　　10. The memory management apparatus according to Claim 9, wherein

2　　　　each generic logical address is a logical address that

3　　is accessed whenever a logical page including a corresponding

4　　generic logical address is accessed.

1　　11. The memory management apparatus according to Claim 1, wherein

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2　　　　each physical page is implemented by a ferroelectric random

3　access memory.

1　12. A memory management apparatus for accessing a physical page

2　mapped according to mapping information to a logical page that

3　includes a logical address specified by an access request, the

4　mapping information showing a one-to-one mapping between a

5　plurality of logical pages and a plurality of physical pages,

6　the logical pages being defined by dividing a logical address

7　space by a predetermined size, each of the physical pages

8　functioning to physically retain data of the predetermined size

9　and degrading in storage performance each time an access is made

10　thereto, the apparatus comprising:

11　　　　an access frequency index storage unit operable to store

12　an access frequency index for each logical page, the access

13　frequency index indicating an occurrence frequency of an access

14　request specifying a logical address included in a corresponding

15　logical page;

16　　　　a cache storage unit operable to store cache data for each

17　of up to a predetermined number of the physical pages in

18　association with a replication access frequency index that is

19　a copy of an access frequency index of a logical page mapped

20　according to the mapping information to a corresponding physical

21　page, the cache data being a copy of data retained in the

22　corresponding physical page and that is accessed instead of the

23　original data; and

24　　　　a degradation leveling unit operable, when one of the

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25　pieces of cache data needs to be replaced with data retained

26　in a new physical page, to replace cache data associated with

27　a replication access frequency index that is less than or equal

28　to an access frequency index of a logical page mapped according

29　to the mapping information to the new physical page.

1　13. The memory management apparatus according to Claim 12,

2　further comprising

3　　　a replication access frequency index updating unit

4　operable, in response to an access to cache data, to decrement

5　a replication access frequency index associated with the cache

6　data.

1　14. The memory management apparatus according to Claim 12,

2　wherein

3　　　each physical page is implemented by a ferroelectric random

4　access memory.

1　15. A memory management method for accessing a physical page

2　mapped according to mapping information to a logical page that

3　includes a logical address specified by an access request, the

4　mapping information showing a one-to-one mapping between a

5　plurality of logical pages and a plurality of physical pages,

6　the logical pages being defined by dividing a logical address

7　space by a predetermined size, each of the physical pages

8　functioning to physically retain data of the predetermined size

9　and degrading in storage performance each time an access is made

10   thereto, wherein

11   the method employs (i) an access frequency index indicating,

12   for each logical page, an occurrence frequency of an access

13   request specifying a logical address included in a corresponding

14   logical page and (ii) a degradation index indicating, for each

15   physical page, a degree of degradation in storage performance

16   of a corresponding physical page,

17   the method comprising:

18   a degradation leveling step of (i) exchanging retained

19   data between a first physical page and a second physical page,

20   the first physical page being mapped according to the mapping

21   information to a specific logical page of which an access

22   frequency index is greater than or equal to a first threshold,

23   and the second physical page having a degradation index that

24   is less than or equal to a second threshold, and (ii) updating

25   the mapping information so as to show that the specific logical

26   page is mapped to the second physical page.

1   16. The memory management method according to Claim 15, further

2   comprising:

3   a cache managing step of storing, for each of up to a

4   predetermined number of the physical pages, cache data that is

5   a copy of data retained in a corresponding physical page and

6   that is accessed instead of the original data, and of writing,

7   if cache data has been modified as a result of a subsequent access,

8   the modified cache data back to a corresponding physical page;

9   and

10　　　　　　a degradation index updating step of adding a first value

11　to a degradation index of each physical page that retains original

12　data of cache data stored in the cache storage step, and adding

13　a second value to a degradation index of each physical page to

14　which modified cache data has been written back.

1　17. The memory management method according to Claim 15, wherein

2　　　　　each logical page has a generic logical address that is

3　included in a corresponding logical page,

4　　　　　the memory management method further comprising:

5　　　　　a detecting step of detecting an access request specifying

6　any of the generic logical addresses;

7　　　　　a degradation index updating step of incrementing a

8　degradation index of a physical page mapped according to the

9　mapping information to a logical page that includes a generic

10　logical address specified by an access request detected in the

11　detecting step; and

12　　　　　an access frequency index updating step of incrementing

13　an access frequency index of the logical page that includes the

14　generic logical address specified by the detected access request.

1　18. A memory management method for accessing a physical page

2　mapped according to mapping information to a logical page that

3　includes a logical address specified by an access request, the

4　mapping information showing a one-to-one mapping between a

5　plurality of logical pages and a plurality of physical pages,

6　the logical pages being defined by dividing a logical address

7　　space by a predetermined size, each of the physical pages

8　　functioning to physically retain data of the predetermined size

9　　and degrading in storage performance each time an access is made

10　　thereto, wherein

11　　　　the method employs (i) an access frequency index indicating,

12　　for each logical page, an occurrence frequency of an access

13　　request specifying a logical address included in a corresponding

14　　logical page and (ii) a degradation index indicating, for each

15　　physical page, a degree of degradation in storage performance

16　　of a corresponding physical page,

17　　　　the method comprising:

18　　　　a cache storing step of storing cache data for each of

19　　up to a predetermined number of the physical pages in association

20　　with a replication access frequency index that is a copy of an

21　　access frequency index of a logical page mapped according to

22　　the mapping information to a corresponding physical page, the

23　　cache data being a copy of data retained in the corresponding

24　　physical page and that is accessed instead of the original data;

25　　and

26　　　　a degradation leveling step of, when one of the pieces

27　　of cache data needs to be replaced with data retained in a new

28　　physical page, replacing cache data associated with a replication

29　　access frequency index that is less than or equal to an access

30　　frequency index of a logical page mapped according to the mapping

31　　information to the new physical page.